With continually improving crystals and better cavity configurations, higher conversion efficiencies and broader tuning ranges are expected.

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CTuH5 **11:15 am**

Distributed Feedback Optical Parametric Oscillator

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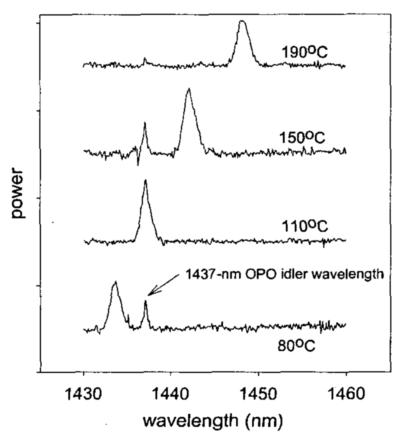
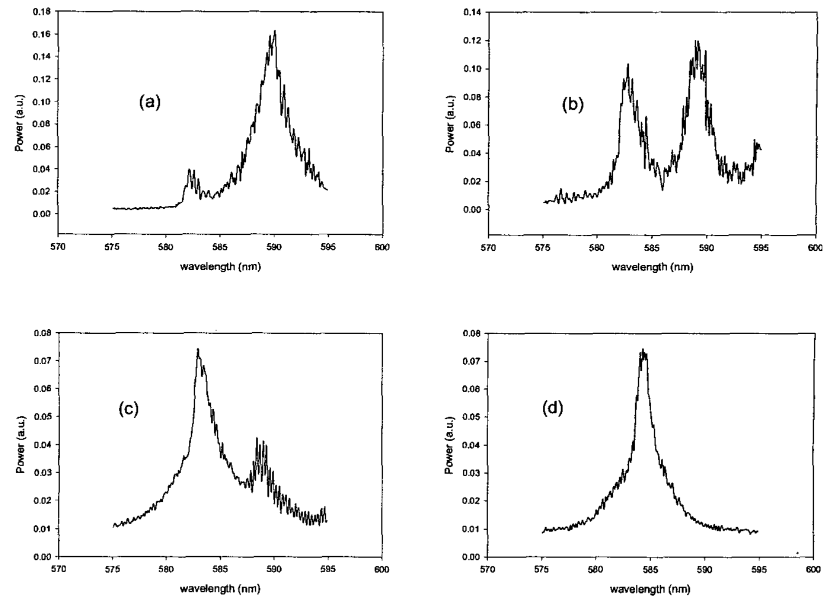
Distributed-feedback (DFB) lasers have the advantage of single frequency operation. We wrote photorefractive distributed-feedback gratings into periodically poled lithium niobate (PPLN) by using a UV grating photomask and by using interfering laser beams.



CTuH5 **Fig. 1.** 1064 nm pumped DFB OPO signal at 80°C, 110°C, 150°C, and 190°C.



CTuH5 **Fig. 2.** 532 nm pumped DFB OPO signal at (a) 110°C (b) 115°C (c) 120°C (d) 130°C.

In the grating mask scheme, incoherent UV radiation from a mercury lamp was illuminated onto a photomask having a 1-µm period grating, which generated a DFB grating inside a 5-cm long, 1-mm thick, 28-µm period PPLN. The 1-µm DFB grating period allows the oscillation of the 4.099-µm signal wavelength in the 1064-nm pumped PPLN optical parametric oscillator (OPO) at 110°C temperature. The corresponding idler wavelength is 1.437 µm. Pumping the DFB PPLN with a 10-µJ/pulse, 730-ps pulsewidth passively Q-switched Nd:YAG laser, we observed the OPO idler laser at 1.437-µm by using an InGaAs detector. Figure 1 shows the OPO and the OPG idler spectra at different temperatures. It is evident from Fig. 1 that, although the OPG wavelength was shifted by temperature, the OPO idler wavelength remained unchanged due to the photorefractive DFB grating in the PPLN. At 110°C, the OPG wavelength overlaps the OPO idler wavelength.

In the interferometric writing scheme, we split and recombined a 100-mW, 532-nm continuous-wave laser to produce 1.25-µm-period interference fringes on a PPLN. By raising up the PPLN temperature to 150°C and cooling it down slowly to the room temperature, the interference fringes induced a photorefractive DFB grating in the 5-cm long, 0.5-mm thick, 12-µm-period PPLN. The 1.25-µm-period DFB grating was designed to oscillate the 5.171-µm OPO signal wavelength in the 532-nm pumped PPLN at 130°C. The pump laser was an actively Q-switched, frequency-doubled Nd:YAG laser producing 200-µJ pulse energy with 10-Hz repetition rate and 10-ns pulsewidth. Figure 2 shows the OPO and OPG idler spectra from the PPLN at different temperatures. It is evident from Fig. 2 that, although the OPG wavelength was tuned by temperature, the OPO idler wavelength remained unchanged due to the photorefractive DFB grating in the PPLN. At 130°C, the OPG wavelength overlaps with the OPO idler wavelength.

In conclusion, we have demonstrated the DFB PPLN OPO by writing a photorefractive grating in a PPLN. The detail properties are under investigating now. The DFB PPLN OPO may leads to novel applications in gas sensing and fiber communications.

CTuH6 **11:30 am**

Semi-monolithic Optical Parametric Oscillator: Infrared Pulsed Single-longitudinal-mode Operation

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Coherent single frequency mid-infrared sources are important for applications in pollutant detection. Up to now, mainly three types are available: semiconductor interband or intersubband (quantum cascade) lasers with about 1 W output peak power and rather small tunability (few 10's of nm), difference frequency generation with low output powers (typically few µW) and cw optical parametric oscillators (OPOs). None of these sources are fit for lidar operation where nanosecond high power (100's W) pulses are needed. Conversely, nanosecond OPOs operating with periodically poled materials (like PPLN) display low threshold and allow thus new compact high repetition rate sources to be used.[1,2] However, the multi-frequency behavior of pulsed OPOs is detrimental for most of applications that require a typical line width of 100 MHz. To fulfill the spectral need, dual-cavity Doubly Resonant Optical Parametric Oscillators (DROPOs) are well suitable since they provide a low threshold of oscillation in combination with compactness. We report here a novel compact nanosecond OPO leading to single-longitudinal-mode output from